

# ARTILLERY IS HERE TO STAY - FOR NOW

A Monograph

by

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## ABSTRACT

THE ARTILLERY IS HERE TO STAY - FOR NOW, by MAJ Sherman C. Watson Jr, 35 pages.

The Field Artillery has to capitalize on emerging opportunities to maintain relevance in a changing environment as the U.S. Army transition from Full Spectrum Operations (FSO) to Unified Land Operations (ULO). This monograph describes how the Field Artillery must change in order to remain relevant in the future. The implementation of TRADOC's broad overarching concept of fires into an effective fighting force requires a holistic assessment of the current state of the Field Artillery. This monograph proposes an alternative option to the current Field Artillery organizational structure to improve the effectiveness of scalable fires, Field Artillery units adaptability for nonstandard missions, and increased role for the Field Artillery in operational and strategic level fires. This monograph recommends expanding the concept of scalable capabilities by decentralizing artillery rocket systems in direct support of brigade combat team and reducing the size of general support artillery units. The Field Artillery can become operationally adaptive by preparing Field Artillery units to conduct specific nonstandard missions when required. Lastly, in order to reestablish the role of the Field Artillery as a relevant option for strategic and operational level fires a direct support relationship between the Field Artillery and special operations forces could increase the use of long-range artillery in support of future operations. As the nature of warfare changes and as the U.S. Army increases responsibility of smaller units the Field Artillery must decentralize artillery units to align the right capabilities to support future requirements.

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## ACRONYMS

AD	Active Defense
ADA	Air Defense Artillery
ALB	Air Land Battle
AOC	Army Operating Concept
CARL	Combined Arms Research Library
CGSC	U.S. Army Command and General Staff College
COIN	Counterinsurgency Operations
DOTMILPF	Doctrine, Organization, Training, Material, Leadership, Personnel, Facilities
FCF	Functional Concept for Fires
FCOE	Fires Center of Excellence
FSO	Full Spectrum Operations
HIMARS	High Mobility Artillery Rocket System
MLRS	Multiple Launched Rocket System
MMAS	Master of Military Art and Science
MOOTW	Military Operations Other Than War
OE	Operating Environment
SADRAM	Search and Destroy Armor Munition
SAMS	School of Advanced Military Studies
TACFIRE	Tactical Fires
TRADOC	Training and Doctrine Command
ULO	Unified Land Operations
USAWC	United States Army War College
CAM	Combined Arms Maneuver
WAS	Wide Area Security

## INTRODUCTION

*“All through the evolution of the artillery, from catapult to missile, its purpose has remained the same: to be the most responsive maneuver element of a commander, and, thereby, to assist the other arms, especially the infantry, upon the field of battle.”<sup>1</sup>*

The Field Artillery has made significant changes in response to the operating environment in Iraq and Afghanistan. These changes were evident by the Field Artillery initiatives to improve precision capabilities, implement tactics, techniques, and procedures (TTPs) to decentralize indirect fire support to lower echelons, and conduct nonstandard missions as a replacement for traditional Field Artillery missions. However, as the United States Army begins to move away from the current fight in Iraq and Afghanistan the Field Artillery is looking to refocus on traditional fires in support of conventional forces. This will mean the Field Artillery will now shift focus from the current fight to preparing for the next possible threat. Iraq and Afghanistan are the first wars in which the Field Artillery has had to adapt in stride to support operations but history may show the reluctance of the Field Artillery to institutionalize lessons learned. The Field Artillery may be at risk of losing the capabilities developed over the past twelve years if recent lessons learned are not included in Field Artillery doctrine to support Unified Land Operations (ULO).

The transition of Training and Doctrine Command's (TRADOC) broad overarching concept for fires into an effective fighting force require an assessment of the current state of the Field Artillery and the development of a plan to minimize gaps in capabilities in order to meet future requirements. The failure to adapt could lead to premature uselessness and greatly increase the risk that the Field Artillery will be incapable of supporting operations in the future. <sup>2</sup>

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<sup>1</sup>U.S. Army Field Artillery School, *Right of the Line: A History of the American Field Artillery*, Ft Sill, OK, 1984, 13.

<sup>2</sup>John M. Shalikashvili, “Joint Vision 2010: America's Military Preparing for

Organizational theorist Bryon Lawson argued that organizations often fail to develop a complete plan because of planning traps.<sup>3</sup> The Field Artillery must avoid developing a force structure that resembles the capabilities needed for the last war. Fires doctrine under ULO must retain flexibility and adaptability as key tenets for the Field Artillery to be prepared to deploy forces against conventional threats like North Korea, Iran, or in support of disaster relief around the world.

The second challenge of the Field Artillery is to transform current capabilities to meet the requirements defined in the Functional Concept for Fires as scalable capabilities. Scalable capability describes Field Artillery capabilities as fires that range from lethal to nonlethal and provides the right amount of lethality to achieve desired effects.<sup>4</sup> Scalable fires as a concept alone cannot change how the Field Artillery operates. The Field Artillery has to institutionalize the concept into doctrine and redefine the structure and capability of the organization to be relevant in future operating environments. As the U.S. Army continues to increase the responsibilities of the brigade combat team as the main fighting force, the Field Artillery has to increase the range of lethal and nonlethal fires supporting smaller organizations. The current Field Artillery doctrine developed to support ULO continues to organize Field Artillery units to operate as the Field Artillery did under FSO. Maneuver units will continue to coordinate with higher headquarters to receive general support artillery fires not resident in smaller organizations.

Since the 1990s, the U.S. military has conducted more stability and counterinsurgency type missions than major combat operations. The U.S. military's increased role in nation building

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Tomorrow," *Joint Force Quarterly* (Summer 1996): 39.

<sup>3</sup>Bryan Lawson, *How Designers Think* (Burlington, MA: Architectural Press, 2006), 26.

<sup>4</sup>U.S. Department of the Army Doctrine Publication (ADP) 3-09, *Fires* (Washington D.C.: Government printing Office [GPO], August 2012), 1.



has led to evolution of U.S. Army doctrine. As the U.S. Army transitions from Full Spectrum Operations (FSO) to ULO the Field Artillery has to capitalize on opportunities to maintain relevance in a changing environment. Throughout history, the Field Artillery has provided shaping fires in support of deep operations, counter fire against enemy artillery threats, and close supporting fires to maneuver forces. These three missions have allowed the Field Artillery to operate across the strategic, operational, and tactical levels of war. The Field Artillery has retained a viable role in counter fire and shaping operations but the increased dependence on fixed wing aircraft for deep strike operations has decreased the requirement for Field Artillery to support shaping operations since the Gulf War. Additionally, the technological improvement of other fires assets like armed unmanned aerial systems (UAS) and attack aviation provide the Department of Defense additional options to defeat long-range enemy threats.

In preparing for the future, the question becomes what should the Field Artillery function, structure, and systems look like and what must the Field Artillery be willing to change to be successful in the future. The TRADOC Army Operating Concept and Functional Concept for Fires 2016-2028 state that the Field Artillery will have to be operationally adaptive and possess scalable capabilities because of the uncertainty associated with future adversaries. The Functional Concept for Fires 2016-2028 defined the requirements for the Field Artillery in five focus areas. The Field Artillery must employ versatile fires capabilities, improve target discrimination, integrate joint fires assets, conduct decentralized operations, and be prepared to conduct or support maneuver operations.<sup>5</sup> All five areas require improvement to the Field Artillery system and organization of weapon systems to meet the requirements outlined in the Functional Concept for Fires 2016-2028. The sections that follow will make the case that Field Artillery doctrine and

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<sup>5</sup>Department of the Army, TRADOC Pam 525-3-4, *Functional Concept for Fires 2016-2028* (Ft Monroe VA: HQs U.S. Army Training and Doctrine Command 2010), 14-19.

transformation plan for the future does not account for all the changes identified in the Army Operating Concept and TRADOC Functional Concept for Fires 2016-2028. Additionally, the Field Artillery has been hesitant to restructure units to increase the capability of Field Artillery battalions supporting brigade combat teams. The cost of failing to look ahead and reflect on lessons learned could result in the Field Artillery having a reduced role in the future.

This monograph is organized into four sections. Section one will describe the enduring role of the Field Artillery and how the Field Artillery's role has been diminishing since the Gulf war. Section two will consist of the literature review to broaden the reader's understanding of how the Field Artillery has changed since Active Defense. The literature review will provide the reader with an understanding of the changes to organizational structure, capabilities, and functions of the Field Artillery. Similar to the U.S Army the uncertainty associated with the enemy threat has had a large role in shaping the structure, function, and organization of the Field Artillery. In section three an assessment of the current state of the Field Artillery will provide the reader an understanding of the current organizational structure, capabilities, and shortfalls that exist in the Field Artillery. Additionally this section will summarize the changes the Field Artillery has implemented to transition from FSO to ULO and how the branch plans to provide scalable fires in the future. The last two sections of this monograph will consist of recommendations and conclusion. These sections will provide an alternative solution to implement the concept scalable fires, increase Field Artillery units' adaptability for nonstandard missions, and increase the Field Artillery role in operational and strategic level fires.

### Enduring Role of the Field Artillery

Since the Revolutionary War, the Field Artillery has supported the U.S. Army ground forces in all forms of warfare from major combat operations to peace keeping. Throughout history, the Field Artillery has always been responsible for neutralizing, suppressing, and

destroying the enemy at the tactical level. At the operational and strategic level, the Field Artillery has been responsible for integration and synchronization of all fire support assets to enable commanders to dominate the operational environment. The Field Artillery remains the primary fires asset under ULO doctrine because of the inherent relationship with conventional maneuver forces and overall cost effectiveness compared to joint systems.

The Field Artillery continues to integrate indirect fires into offensive, defense, and stability operations by providing close supporting fires to maneuver forces, counter fire, and interdiction fires. Close support fires enable maneuver units to rapidly multiply the effects of combat power and shift fires rapidly to influence the outcome of operations. Counter fire provides proactive and reactive defense measures against enemy artillery threats to protect friendly forces.<sup>6</sup> The U.S. Army will continue to depend on the Field Artillery in the near future to provide close supporting fires to maneuver forces and counter fire to destroy enemy artillery. Even though the U.S. Army has increased dependence on fixed wing assets, the Air Force cannot dedicate enough close air support to replace the capabilities of the Field Artillery in the near future. Additionally the Air Force cannot provide illumination, smoke, or guarantee a twenty-four hour response capability in support of ground operations. The area that the Field Artillery has lost relevance is deep strike or shaping operations because the Field Artillery deep strike capabilities lack operational reach in terms of deployment responsiveness.

#### Diminishing Role of the Field Artillery in Recent Wars

During the past twenty-two years, Army transformation has eliminated Corps and Division Artillery headquarters because of multiple factors but mainly because of Department of

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<sup>6</sup>Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics, *Report of the Defense Science Board Task Force on Integrated Fire Support in the Battlespace* (Washington, D.C.: Defense Science Board, October 2004), 2.

Defense increased emphasis on precision capability, joint interdependence of fires, and the nature of evolving threats. The Field Artillery has lost relevancy at the operational and strategic level of war based on the limited role of Field Artillery units during the initial phases of theater shaping operations in Iraq and Afghanistan. The Air Force success at locating and destroying targets during the Gulf war overshadowed the Field Artillery contributions to interdiction operations.<sup>7</sup> Throughout the 1990s, the Air Force became the preferred option for strategic and operational fires because of Department of Defense increased emphasis on responsiveness, precision, and operational reach. In 1995 and 1999, the Department of Defense used air power in Bosnia and Kosovo to achieve political objectives. In 2001, the Air Force conducted air campaigns in conjunction with U.S. Special Forces in Afghanistan in the war against terrorism.<sup>8</sup>

Since the 1990s, the U.S. military has been involved in a range of operations around the world and has been able to successfully complete missions without large quantities of indirect fire. Over the past twelve years special operations forces (SOF) has increased operations in support of the global war on terrorism and the Field Artillery has not capitalized on the opportunity to establish a fire support relationship to support SOF operations. The inability of the Field Artillery to operate outside of its traditional role of supporting conventional operations has decreased the use of indirect fires at the operational and strategic level. Yaneer Bar-Yam in *Making Things Happen* talked about parts, wholes, and relationships when solving complex problems. Bar-Yam used the analogy of not being able to see the forest because of the trees to

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<sup>7</sup>Jody Jacobs, *Enhancing Fires and Maneuver Capability Through Greater Air Ground Joint Interdependence* (Santa Monica, CA: RAND, 2009), 24.

<sup>8</sup>John J. McGrath, *Fire for Effect: Field Artillery and Close Air Support in the U.S. Army* (Ft Leavenworth Kansas: Combat Studies Institute Press, 2008), 146-150.

emphasize the importance of the relationship between the details of a system and the larger view.<sup>9</sup> The Field Artillery has failed to capitalize on opportunities to expand the role of organic precision rocket and missile systems to support other joint assets. The Field Artillery emphasis on centralized control of fires as the most efficient means of distributed fires has limited the Field Artillery ability to adapt. Throughout history, the Field Artillery has centralized long-range capabilities in Field Artillery brigades to control and synchronize fires assets.

In contrast to the U.S. Air Force, the Field Artillery does not have a dedicated deep strike organization. Nor does the Field Artillery have units strategically positioned around the world to increase operational reach. Five of the Field Artillery brigades are located in the continental United States and only one brigade is located overseas in South Korea. The Field Artillery has not been successful at integrating deep strike capability in recent operations. Analysis of U.S. military involvement in operations in Kosovo (1999), Afghanistan (2001), and Iraq (2003), show that there has been a shift between the roles of ground and airpower in shaping major operations.<sup>10</sup> During initial operations in OIF, the Army's V Corps artillery fired only 414 ATACMS.<sup>11</sup> In contrast, the coalition air forces flew 20,733 sorties between March 19 and April 18, 2003, using 735 fighters and 51 bombers, and struck more than 15,592 interdiction or deep operation type targets.<sup>12</sup> While proudly earning the title "King of Battle" for its vital contributions

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<sup>9</sup>Yaneer Bar-Yam, *Making Things Work: Solving Complex Problems in a Complex World* (Boston, MA: Knowledge Press, 2004), 27.

<sup>10</sup>David E. Johnson, *Learning Large Lessons: The Evolving Roles of Ground Power and Airpower in the Post-Cold War Era* (Santa Monica, CA: RAND, 2007), 43.

<sup>11</sup>*Ibid.*, 159.

<sup>12</sup>*Ibid.*, 163.

in every major operation since the Revolutionary War, the Field Artillery's role in military operations seems to be diminishing since the conclusion of the Cold War.<sup>13</sup>

## LITERATURE REVIEW

All human institutions must deal with the tension between continuity and change, between preserving that which has met the needs of the past and adapting to the challenge of change in an uncertain future.<sup>14</sup> Throughout history, both internal and external factors have challenged the Field Artillery to implement the proper force structure to support maneuver forces. Field Artillery historians have documented the evolution of the organization, doctrine, and structural changes of the Field Artillery extensively. Boyd Dastrup described changes within the Field Artillery within two categories: internal and external.<sup>15</sup> Internal causes of change in the Field Artillery are organizational interest, organizational process, and bureaucratic politics. External causes of change in the Field Artillery are technology, threat, failure or shortfall in recent wars, and resource availability.

Boyd Dastrup's analysis suggests that emerging threats and uncertainty about emerging threats has been the biggest catalyst for organizational change. The Field Artillery is familiar with

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<sup>13</sup>Major General H. G. Bishop was the first person to call the Field Artillery "King of Battle" in 1935 because of the historic success of the Field Artillery on the Battlefield in American history. (U.S. Army Field Artillery School, *Right of the Line: A History of the American Field Artillery*, Ft Sill, OK, 1984, 11).

<sup>14</sup>David R. Mets and Harold R. Winton, *The Challenge of Change* (Lincoln, Nebraska: University of Nebraska Press, 2000), xii.

<sup>15</sup>Boyd Dastrup, the Fires Center of Excellence historian, monograph series on the history of Field Artillery is a detailed analysis of the Field Artillery that spans from the origin of U.S. Field Artillery to the 2004. Dastrup's summary of Field Artillery history is a detailed account of changes in the organization, material, doctrine, and training of the Field Artillery. Dastrup provided the most detailed explanation of the impact of changes in the Army on the future of the Field Artillery throughout the Field Artillery history. Boyd L. Dastrup, *King of Battle: A Branch History of the U.S. Army's Field Artillery* (Ft Monroe, VA: HQ US Army TRADOC Office of the Command Historian, 1991).

periods of uncertainty in the years immediately following a war. Between the Korean War (1951-1953), Vietnam War (1965-1973), and the Cold War (1947-1990), the Field Artillery implemented multiple transformations to develop the proper force capability. In recent years, the Field Artillery has been slow to develop doctrine for the employment of Field Artillery units in stability operations in 2003. Under FSO doctrine, the Field Artillery failed to establish relevant doctrine for how Field Artillery would support stability operations. Because of the lack of relevant doctrine, Field Artillery brigades and battalions performed nonstandard missions in Iraq and Afghanistan without training and preparation. Field Artillery battalions that did provide lethal and nonlethal fires in Iraq and Afghanistan during stability operations depended on emerging tactics, techniques, and procedures (TTPs) because Field Artillery doctrine for stability operations did not exist.

The U.S. Army has implemented its fourth change in capstone doctrine and operating concept since Active Defense. Each time the Army doctrine change the Field Artillery has to develop a plan to update doctrine and restructure the Field Artillery to be successful. Henry Mintzberg in *The Rise and Fall of Strategic Planning* stated that intended strategies rarely become realized strategies because perfect realization implies brilliant foresight and inflexibility.<sup>16</sup> Because of uncertainty associated with future threats and the increased responsibility of the U.S. Army to operate across the spectrum of conflict, flexibility and adaptability are essential in military planning. Henry Mintzberg warned planners to avoid becoming wedded to ideas that may need to evolve or change over time. A study of Active Defense, AirLand Battle, and Full Spectrum Operations show that the Field Artillery has been more successful in some areas of organizational change than in others. Even though the Field

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<sup>16</sup>Henry Mintzberg, *The Rise and Fall of Strategic Thinking* (New York: The Free Press, 1994), 24.

Artillery has performed nonstandard missions in support of military operations throughout history, the Field Artillery has not included nonstandard missions into doctrine to prepare units during home station training.

### Active Defense

The U.S. government continued involvement in conflicts around the world throughout the 1970s strained the availability of military forces to defend Western Europe. Confronted by a numerically larger threat in Europe, the U.S. Army's operating concept in the 1970s placed emphasis on defensive actions with large quantities of firepower.<sup>17</sup> Key tenets of Active Defense doctrine were lethality, firepower over manpower, and superiority of mechanized systems.<sup>18</sup> The Soviet Union's numerical superiority threatened the sovereignty of European nations and outnumbered U.S. military and NATO forces.

Active Defense divided the battlefield into three main areas but concentrated friendly efforts on the main battle area and assumed risk in the rear area and the covering force area. All indirect fires under Active Defense were essentially tactical because targeting efforts focused on the main battle area.<sup>19</sup> The concentration of fires in the main battle area did not require the Field Artillery to improve capability to conduct shaping fires under Active Defense doctrine. The Field Artillery focused efforts to improve close support fires to maneuver forces and counter fire but failed to develop a capability to interdict enemy forces within the depth of the corps zone of

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<sup>17</sup>Dastrup, *King of Battle: A Branch History of the U.S. Army's Field Artillery*, 300.

<sup>18</sup>U.S. Department of the Army Field Manual 100-5, *Operations* (Washington D.C.: Government printing Office [GPO], July 1976), 2-23.

<sup>19</sup>John L. Romjue, *From Active Defense to Air Land Battle: The Development of the Army Doctrine, 1973-1982* (Ft Monroe, VA: HQ TRADOC Office of the Command Historian, 1984), 23.



operations. In 1973, corps formations replaced field armies as the main fighting force for U.S. Army land operations. The U.S. Army eliminated artillery groups and decentralized Field Artillery assets to support corps and division headquarters.<sup>20</sup> The Corps artillery was responsible for counter fire and reinforcing artillery support for division operations. Efforts to improve responsiveness of fires included assigning fire support personnel to maneuver units for planning and integration, increased target acquisition capability organic at the division level, and increased division artillery organizational structure to increase the capability of direct support units.

In support of Active Defense, the Field Artillery focused research and development primarily on improving existing systems instead of fielding new equipment. The Field Artillery initiatives under Active Defense improved responsiveness of fires, lethality, and weapon system range. Cannon artillery increased accuracy out to thirty kilometers and the Multiple Launch Rocket System (MLRS) provided a long-range counter fire capability that delivered twelve rockets in a short amount of time. Both cannon and rocket systems were integrated with Tactical Fires (TACFIRE) a fire control system.<sup>21</sup> TACFIRE increased the responsiveness of fire with automated data computation and digital transmission of information to weapon systems.

The Copperhead, and Search and Destroy Armor Munitions (SADRAM) were the first precision munitions fielded by the Field Artillery.<sup>22</sup> The purpose of these munitions was to increase the capability to destroy tanks and decrease excessive ammunition expenditure. Even though the Field Artillery had fielded the Copperhead and Search and Destroy Armor Munitions (SADRAM) the Field Artillery remained an area fired weapon system with large logistical

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<sup>20</sup>Janice E. McKenney, *The Organization of the Field Artillery: 1775-2003* (Washington D.C.: Center of Military History, 2007), 306.

<sup>21</sup>*Ibid.*, 301.

<sup>22</sup>Jonathan Bailey, "Field Artillery - Enduring Importance and Future Challenges." *Military Technology*, (September 2005): 118.

requirements. The Field Artillery precision capability was in its infancy in the 1970s and needed many years of research and development to resolve issues associated with the Copperhead and Search and Destroy Armor Munitions. The Field Artillery effort to improve capability under Active Defense greatly enhanced the Field Artillery system against the Soviet threat but the U.S. Army still lacked the overall ability to win decisively.

The U.S. Army replaced Active Defense with Air Land Battle (ALB) as capstone doctrine in 1981 because Active Defense failed to meet the needs of the U.S. Army as a global response force. Active Defense was an interim doctrine to defend European allies against Soviet threat and was not applicable for U.S. military operations in other parts of the world. Active Defense doctrine is an example of the U.S. Army failure to develop a universal operating concept with the flexibility and adaptability to operate in multiple operating environments.

#### Air Land Battle

The Soviet Union remained the U.S. government's primary threat throughout the Cold War period. By the mid-1970s senior Army leaders felt that the Active Defense operating concept was too reactionary and did not provide the U.S. a favorable chance to win in Europe or in other conflicts. TRADOC completed a review of Active Defense doctrine and determined a new operating concept was necessary to allow U.S. forces to be more offensive oriented and less vulnerable to threat actions. General Donn Starry, TRADOC Commander, defined key tenets of ALB as initiative, agility, depth, and synchronization.<sup>23</sup> Significant to implementation of ALB were the concept of integrated battlefield, operational art, deep operations, and corps centric

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<sup>23</sup>U.S. Department of the Army Field Manual 100-5, *Operations* (Washington D.C.: Government printing Office [GPO], July 1976), 12.

operations that defined how the Army would operate in the future.<sup>24</sup> The emerging operational concept ALB aimed to resolve shortfalls in Active Defense doctrine, mainly the inability of U.S. forces to conduct operations in depth to shape the battlefield.<sup>25</sup>

The ALB concept expanded the role of corps headquarters to be responsible for more terrain on the battlefield specifically depth. Corps headquarters were responsible for interdicting second and third echelon enemy forces prior to the primary engagement by division formations, which became the main fighting force for close engagements under ALB. ALB emphasis on the extended battlefield required the Field Artillery to develop a deep strike capability. The corps artillery provided shaping fires to defeat the enemy second and third echelon forces and provide counter fire to defeat large enemy artillery organizations.<sup>26</sup>

The requirements of the ALB concept served as the basis for Field Artillery systems acquisition. The Field Artillery improved the capability of older weapon systems and fielded new weapon systems to increase lethality and range of counter-fire systems to neutralize Soviet artillery threat. MLRS launchers fielded in the 1970s became the solution for responsive counter-fire after improvements in displacement tactics and munitions. The M109 self-propelled howitzer replaced World War II type systems in heavy Field Artillery units to provide the maneuver capability to complement the speed of U.S. M1 (Abrams) main battle tank and M2 (Bradley)

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<sup>24</sup>The Corp '86 Concept was the Army's Operating Concept implemented in 1986 that was based around the Corps formation. In 1973, field armies were eliminated and corps formations increased to include additional fire support units that became known as the corps artillery. (McKenney, *The Organization of the Field Artillery: 1775-2003*, 306-307).

<sup>25</sup>Boyd L. Dastrup, *Modernizing the King of Battle 1973-1991*. (Ft Sill, OK: Office of the Command Historian U.S. Army Field Artillery Center and School, 2003), 13.

<sup>26</sup>*Ibid.*, 24.

infantry fighting vehicle.<sup>27</sup> The M109 fielding program consisted of multiple modernization efforts, and by 1990 the M109A6 Paladin had similar capabilities of MLRS systems with rapid displacement and on board fire control systems. Rapid displacement and on board fire control systems increased the survivability and responsiveness of the Paladin as a legitimate counter fire and close support weapon system for maneuver forces.

One of the key lessons learned from the Gulf War for both the U.S. Army and the Field Artillery was that the mechanized force was too heavy to be responsive and required extensive logistics to sustain. Secretary of Defense Donald Rumsfeld stated that the U.S. Army operating concept ALB was the wrong approach for future military operations because large mechanized formations were not responsive enough for future U.S. government requirements.<sup>28</sup> The U.S. Army deployed forty-three field artillery battalions with two hundred ninety six howitzers and seven MLRS battalions to provide field artillery support to U.S. maneuver forces at a ratio of one field artillery battalion to one maneuver battalion.<sup>29</sup> Even though the Field Artillery was successful during the Gulf War, the time required to deploy large forces were not guaranteed in the future. During the second Iraq War in 2003 the ground forces began major operations with only a fraction of the anticipated Field Artillery units because the Field Artillery had not resolved the issue of responsiveness from the Gulf War.

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<sup>27</sup>Major General Toney Stricklin, U.S. Army, "The Field Artillery in Transformation." *Field Artillery*, (September-October 2000): 2.

<sup>28</sup>Johnson, *Learning Large Lessons: The Evolving Roles of Ground Power and Airpower in the Post-Cold War Era*, 68.

<sup>29</sup>McGrath, *Fire for Effect: Field Artillery and Close Air Support in the U.S. Army*, 143.

### Full Spectrum Operations

Throughout the 1990s, the United States government experienced a shift in strategic focus from a unified Soviet threat to increased responsibility to respond to a broad variety of contingencies around the world. After U.S. military involvement in conflicts in Somalia, Bosnia, and Kosovo the inclusion of operations other than war led to the U.S. Army implementing FSO in 2001 as the Army's future operating concept. The U.S. Army eliminated the ALB concept of containment and implemented a military strategy of force projection enabled by technological superiority and global responsiveness under FSO.<sup>30</sup> The Army defined full spectrum operations as a range of military operations that the Army must be able to conduct from peacetime military engagement to major combat operations.<sup>31</sup>

FSO was an evolutionary concept to improve land forces capability to conduct decentralized operations. At the beginning of the twenty first century, the Army initiated transformation to achieve a lighter smaller force built around the brigade combat team to increase responsiveness. The brigade combat team enhanced by technologically advanced communication systems, increased lethality, and maneuverability became the main fighting force for the U.S. Army. In 2002, Secretary of Defense Rumsfeld canceled the Crusader system, which was the first new Field Artillery self-propelled howitzer scheduled for fielding since the 1960s. The Crusader howitzer was capable of increased range and firing accurately on the move.<sup>32</sup> Secretary of Defense Rumsfeld's decision to cancel the Crusader was a continuation of the diminishing role of

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<sup>30</sup>Romjue, *From Active Defense to Air Land Battle: The Development of the Army Doctrine, 1973-1982*, 42.

<sup>31</sup>U.S. Department of the Army Field Manual 3-0, *Operations* (Washington D.C.: Government printing Office [GPO], July 1993), 1-1.

<sup>32</sup>McGrath, *Fire for Effect: Field Artillery and Close Air Support in the U.S. Army*, 149.

the Field Artillery that began in the mid-nineties. By 1995, the U.S. Army reduced ninety-six total active Field Artillery battalions to fifty.<sup>33</sup>

The Field Artillery performance during OIF I was similar to Field Artillery operations during the 1991 Gulf War. Corps and division artillery successfully provided interdiction fires, counter fire, and general support artillery while organic Field artillery units provided responsive close support fires to maneuver forces. During OIF I, Field Artillery units dominated Iraqi artillery systems with improved target acquisition systems and close supporting fires provided to maneuver forces.<sup>34</sup> The Air Force dominated the initial phase of OIF I with interdiction fires and set conditions for a quick transition to stability operations. The successful air campaigns by joint forces and the effectiveness of attack aviation decreased the requirement for Field Artillery at the operational and strategic level to shape deep operations. The Field Artillery contribution to shaping operations were 414 ATACMS missiles, a relative small amount for one corps artillery and two division artillery units that consisted of three fires brigades, and eleven battalions.<sup>35</sup>

The Field Artillery provided the same lethality during OIF I with one third of Field Artillery units used in the Gulf War validated that large artillery formations were not needed for future operations.<sup>36</sup> Therefore, during the restructuring of the Field Artillery following OIF I, the U.S. Army eliminated corps artillery units, eliminated division artillery headquarters, aligned Fires brigades with division headquarters, and assigned Field Artillery battalions directly to maneuver brigades in order to decentralize fires capability to enhance division and brigade

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<sup>33</sup>McKenney, *The Organization of the Field Artillery: 1775-2003*, 317.

<sup>34</sup>*Ibid.*, 320.

<sup>35</sup>Jacobs, *Enhancing Fires and Maneuver Capability Through Greater Air Ground Joint Interdependence*, 24.

<sup>36</sup>McGrath, *Fire for Effect: Field Artillery and Close Air Support in the U.S. Army*, 155.

operation.<sup>37</sup> Under Army transformation, the Field Artillery focused on improving the capability of weapon systems fielded in the 1960s to meet the needs outlined in FSO doctrine. The Field Artillery improved deep strike precision capability with the MLRS ATACMS unitary missile.<sup>38</sup> The ATACMS was a multipurpose munition effective against personnel, lightly armored targets, and long range enemy command post.

#### FIELD ARTILLERY STRUCTURE, CAPABILITIES, AND SHORTFALLS

The Field Artillery has always focused on improving capabilities of individual subsystems to increase weapon accuracy and range, munition lethality, and target discrimination. These modifications have been necessary throughout the history of the Field Artillery to ensure that U.S. Army capabilities can match or dominate the enemy. The U.S. Army typically replaces weapon systems with new and emerging technology when current systems cannot dominate or match the capabilities of emerging threats. The Field Artillery modernization program has been able to improve the capability of the same Field Artillery systems that have supported U.S. Army doctrine since Active Defense. As the Field Artillery transitions from FSO to ULO doctrine, the capability of current howitzer weapon systems will not hinder the Field Artillery from transforming to meet the needs of ULO. The retention of current howitzer systems with future modifications to improve capabilities provide the U.S. Army a better solution in a budget-constrained environment than the uncertainty associated with fielding new systems not validated in combat. The Department of Defense decisions to cancel the Crusader and Non-line of Sight systems had less impact on the Field Artillery ability to support U.S. Army capstone doctrine than

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<sup>37</sup>McKenney, *The Organization of the Field Artillery: 1775-2003*, 319.

<sup>38</sup>*Ibid.*, 320.

the Field Artillery reluctance to restructure units to provide scalable capabilities and train units to be prepared to conduct nonstandard missions in the future.

The Field Artillery is a system of systems organization whose effectiveness depends on the efficiency of subsystems and not individual parts. The best way to describe the Field Artillery sensor to shooter linkage is using Jamshid Gharajedaghi system methodology known as holistic thinking. Jamshid Gharajedaghi stated that holistic thinking focus on seeing the whole by understanding the structure, function, process, and context of the system at the same time.<sup>39</sup> Four broad categories describe current Field Artillery capabilities. The first category is command and control, which includes the structuring of forces, communication systems, and redundancy of capability through joint coordination. Secondly, the delivery weapon systems include all primary indirect fire weapon systems that support U.S. Army operations from tactical to strategic. Third, sensors and target acquisition are the assets that acquire, locate, identify, and complete battle damage assessments of targets. Sensors are a complement of personnel and equipment that facilitate accuracy and effectiveness of fire support systems. Finally, munitions include a mix of area fired artillery rounds, guided unitary rockets, and precision guided missiles that range from lethal to nonlethal.

#### Command and Control

The current Field Artillery structure aligns Fires brigades with division headquarters and Field Artillery battalions with Armored, Infantry, and Stryker brigades. The current structure consists of seven Fires brigades to support ten active Army divisions with several of the Fires brigades supporting more than one division. The Field Artillery approved plan for restructuring the Field Artillery in support of ULO will increase the number of Fires brigades from seven to ten

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<sup>39</sup>Jamshid Gharajedaghi, *Systems Thinking* (Burlington, MA: Elsevier, 2006), 108-110.



by 2016.<sup>40</sup> The function of the Fires brigades is to operate as the force field artillery headquarters for all Field Artillery units assigned to the division, support corps or land component headquarters with shaping fires, provide the division with general support fires, and integrate all fires assets within the division. Fires brigades remain relevant under the current structure because the Field Artillery has centralized MLRS and HIMARS capabilities within these organizations. Even though Fires brigades align with division headquarters, most ATACMS type missions are in direct support of operational and strategic level targeting. Additionally a large amount of the rockets that were fired during OIF I were in general support of brigade combat teams operations.<sup>41</sup>

Each maneuver brigade Field Artillery battalion synchronizes all indirect artillery assets and establishes supporting relationships with maneuver battalions based on mission requirements. Each Field Artillery battalion in an Armored or Infantry brigade has two firing batteries with eight howitzers in each battery. The Armored brigades have Paladin systems and Infantry brigades have M119A2 towed howitzer systems. Stryker brigades have an additional infantry battalion therefore requiring increased indirect fire capability. Stryker brigades have three firing batteries with six M777 towed howitzers in each battery. Field Artillery systems that support Armored, Infantry, and Stryker brigades have the capability to mass fires, provide limited precision fires, and can operate decentralized at risk of the Field Artillery battalion not maintaining the capability to mass fires. The war in Afghanistan provides evidence of the limitation of the current structure of Field Artillery battalion. Field Artillery units are operating

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<sup>40</sup>Brigadier General Brian McKiernan, U.S. Army, “Shaping the Future: In an Uncertain Environment.” Fires Center of Excellence, <https://www.us.army.mil/suite/2012fieldartillerybrief> (accessed on 10 January 2013).

<sup>41</sup>Marine Corps University, *U.S. Field Artillery Relevance on the Modern Battlefield* (Quantico, VA: Marine Air Ground Training and Education, Combat Development Command, 2004), 9.

decentralized from forward operating bases with two to three gun elements spread throughout area of operations do not have the capability to mass fires because of the terrain and the increased size of the brigade operating environment. Organic Field Artillery weapon systems inability range targets throughout assigned areas has increased dependence on close air support which is not always responsive or available.

Communication is the catalyst that links all components of the Field Artillery system to allow the Field Artillery to support deep operations, provide timely counter fire and close support fires for maneuver forces. Even though the Advanced Field Artillery Tactical Data System (AFATDS) is the primary system for technical firing solutions and synchronization, tactical fire direction operates primarily over tactical radios. The Army tactical field radio links the entire Field Artillery system together to communicate. The SINCGARS tactical radio has proven its dependency but it has a limited range of twenty-five kilometers.

The Field Artillery is the lead for the Fires Center of Excellence to integrate joint fires into planning and execution of operation. The Field Artillery is responsible for leading the targeting process and allocating the proper capability to achieve ground commander's desired effects at every organizational level in the U. S. Army from company to land component commander. ULO doctrine require operational adaptive fires to match a wide range of targets with the right sensor and the right effect to achieve timely, effective, and efficient fires in a wide range of environments and operational conditions.<sup>42</sup> Joint fires have increased the lethality and responsiveness of fires for the ground commander. The capability of joint fires to acquire, engage, and assess targets has benefited the ground commander's ability to shape his area of operation.

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<sup>42</sup>Department of the Army, TRADOC Pam 525-3-4 *Functional Concept for Fires* 2016-2028, 9.

The Air Force has embraced the concept of providing close air support (CAS) to ground forces but close air support is not the primary objective of the Air Force. The Air Force's concept of air apportionment prioritize available air assets to meet Air Force primary objective of strategic engagement and maintaining air superiority before allocating support to ground forces.<sup>43</sup> A limitation of joint assets is the lack of organic capability within the U.S. Army to control aircraft for weapon release. Coordination for joint assets specifically close air support has to be coordinated through Air Force Terminal Air Control Party (TACP) personnel. The constraint with this mechanism is the shortage of TACPs available to support Army operations and the delay created on responsiveness of fires. The integration of Air Force close air support into ground operations will remain limited in scope as long as the Field Artillery fire support observers have limited control of fixed wing assets.

#### Field Artillery Weapon Systems

All current Field Artillery primary weapon systems have been in the Field Artillery as a variant of older systems. Over the past twenty years, the Field Artillery has extended the life expectancy of these systems through modernization programs. After the cancellation of Future Combat System, the Field Artillery continued to conduct improvements to current systems to improve overall capabilities. Primary weapon systems for the Field Artillery are a mix of light, medium, and heavy track and towed artillery pieces. The M119A2 (105mm) towed howitzer is traditionally organic to airborne, air assault, and light divisions. The M777 (155mm) towed howitzer is organic to Stryker brigades.<sup>44</sup> The M109A6 (Paladin) is organic to armored divisions and fires brigades. The M109A6 Paladin fielded in 1994 as a part of the Howitzer Improvement

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<sup>43</sup>McGrath, *Fire for Effect: Field Artillery and Close Air Support in the U.S. Army*, iii.

<sup>44</sup>McKenney, *The Organization of the Field Artillery: 1775-2003*, 288.

Program (HIP) included GPS capability to determine howitzer location, a fire control system to compute firing data, and an upgraded communication system to communicate digitally with the fire direction center. The Field Artillery missile and rocket launchers have both track and wheeled capabilities. The M270A1 Multiple Rocket Launch System (MLRS) is a heavy track launcher traditionally located in the Fires brigade to support division, corps, and theater operations.<sup>45</sup> The M142 High Mobility Artillery Rocket System (HIMARS) fielded in 2003 are wheeled systems capable of air transport to support light infantry, corps, and theater operations.

As technology has improved the capability of systems, the Field Artillery has decreased the number of systems organic to organizations. The number of Paladin systems assigned to support maneuver brigades decreased from twenty-four in the 1980s to eighteen in the 1990s, to sixteen Paladins in each fires battalion in 2013. Field Artillery weapon systems need to be able to operate decentralized, retain the capability to mass fires, and deploy quickly. The efforts of the Field Artillery to improved weapon system range and range of communication systems enable smaller firing elements to mass in space and time.<sup>46</sup>

### Sensors and Target Acquisition

Sensors provide a capability that enables the other key functions of the Field Artillery system to operate. Having a precision weapon is not enough to achieve an acceptable operational precision targeting capability the Field Artillery must also be able to detect, locate, identify, and assess damage to targets.<sup>47</sup> Current sensors used by the U.S. Army specifically for fire support

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<sup>45</sup>Ibid., 291.

<sup>46</sup>Department of the Army, TRADOC Pam 525-3-4 *Functional Concept for Fires* (Ft Monroe VA: HQs U.S. Army Training and Doctrine Command, 2010), 12-13.

<sup>47</sup>Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics, *Report of the Defense Science Board Task Force on Integrated Fire Support in the Battlespace* (Washington, D.C.: Defense Science Board, October 2004), 13.

includes fire support observers whose capabilities are enhanced by a complement of radars, unmanned aerial systems, and technical systems. Fire support personnel help maneuver organizations plan and integrate fires down to platoon level. The Q-36 (Fire-finder) and the Q-37 (Counter-fire) radar have been the primary radar for the Field Artillery since the Korean War. Current radar systems both Q-36 (Fire finder), and Q-37 (Counter fire) radars are directional and cannot provide 360 degree capability to intercept in flight rockets, artillery, and mortars. Wide area security and combined arms maneuver require passive defensive measures to protect friendly forces, population centers, and critical infrastructure.<sup>48</sup> Additionally, legacy systems have been in use since the Cold War are limited in capability specifically accuracy, range, and responsiveness.

Accurate target location increases the effectiveness and efficiency of all types of indirect and joint fires by minimizing the number of munitions required to achieve the desired effects. The future force will require a capability to locate targets accurately with sufficiently low target location error (TLE) to employ joint and organic munitions effectively. These capabilities include lightweight sensors for dismounted operations, sensors for ground combat and aerial platforms, 360-degree weapons locating sensors for offensive and defensive fires, fusion of sensors, and precision targeting software and imagery.<sup>49</sup> Major shortfalls still exist with networkability of sensors to include Joint and multinational sensors interoperability challenges and reducing target location error to increase accuracy and precision. The Field Artillery is scheduled to field new radar systems in the coming years but it will take years to work through short falls and develop a system to meet the needs of the force.

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<sup>48</sup>Major General Davis D. Halverson and Colonel Steven L. Hite, “Adaptable Fires in Support of Full Spectrum Operations” *Army*, July 2011, 36.

<sup>49</sup>Department of the Army, TRADOC Pam 525-3-4 *Functional Concept for Fires* (Ft Monroe VA: HQs U.S. Army Training and Doctrine Command, 2010), 13.

### Area and Precision Munitions

Munitions play an important role in the Field Artillery System. Munitions offset the requirement for number for personnel and systems needed to defeat the enemy. The U.S. Army still foresees the need to retain a mass fires capability in the future. A study of the use of fires in OIF I concluded that massed fires remain effective for suppressing concentrated array of forces and that precision targeting is not required when a large number of targets are in a given area.<sup>50</sup> The cost effectiveness of the artillery projectiles to joint service and precision munitions is one of the key reasons for retaining the Field Artillery as a relevant organization. Artillery area projectiles normally cost \$500, the Excalibur GPS round cost \$36,000, a MLRS missile cost \$100,000, and a standard close air support bomb cost on average \$300,000.

Operations in Iraq and Afghanistan has proven a need for more precision capability at lower echelons of the force to provide offensive and defensive fires in support of counterinsurgency and stability operations. The evolution of technology has enhanced the availability of military precision capabilities by improving availability of precision munitions at smaller organizations. The Excalibur munition was the first near precision projectile to provide organic precision capabilities to brigade and below organizations. Currently, precision capabilities have a circular error probable (CEP) of less than 10 meters. Near-precision capabilities have a CEP between 10 and 50 meters. Area capabilities have a CEP greater than 50 meters.<sup>51</sup> Even though emphasis is on improving precision lethal capabilities, the Field Artillery

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<sup>50</sup>Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics, *Report of the Defense Science Board Task Force on Integrated Fire Support in the Battlespace* (Washington, D.C.: Defense Science Board, October 2004), 21.

<sup>51</sup>Kirby Brown, "Field Artillery Capabilities Update." FCOE Capabilities Development and Integration Directorate, [http://www.dtic.mil/ndia/2008psa\\_peo/Brownday2.pdf](http://www.dtic.mil/ndia/2008psa_peo/Brownday2.pdf) (accessed on 12 January 2013).

needs to expand nonlethal capabilities beyond providing illumination and smoke. By expanding nonlethal munitions, the Field Artillery can increase its contribution to stability operations.

#### FIELD ARTILLERY TRANSITION TO ULO DOCTRINE

In 2011, the U.S. Army published ULO as its new operating concept and capstone doctrine following twelve years of conflict in Iraq and Afghanistan. ULO is not a shift in operational concept; ULO builds on ALB and FSO by integrating the lessons learned from years of war specifically conducting operations in conjunction with joint, interagency, and multinational partners.<sup>52</sup> Combined Arms Maneuver (CAM) and Wide Area Security (WAS) are ULO core competencies to synchronize the use of resources to achieve commander's objectives. CAM is the synchronization of friendly actions in regards to enemy, terrain, and ensuring friendly forces maintain a position of advantage. WAS is the synchronization of resources to protect friendly elements, the population, and denying the enemy position of advantage.<sup>53</sup> The core functions of the Field Artillery, as the U.S. Army's primary indirect weapon system has not changed in the new operating concept ULO. The Field Artillery role is to deliver Field Artillery fires and provide fire support to maneuver forces. Fire support still includes shaping fires, counterstrike, and close support fires, which has been the enduring mission for the Field Artillery since ALB doctrine.<sup>54</sup>

A point of emphasis in ULO is that the Field Artillery will be required to have the versatility to provide the appropriate lethal and nonlethal fires to support offensive, defensive, or

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<sup>52</sup>U.S. Department of the Army Doctrine Publication (ADP) 3-0, *Unified Land Operations* (Washington D.C.: Government printing Office [GPO], October 2011), Foreword.

<sup>53</sup>*Ibid.*, 6.

<sup>54</sup>Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics, *Report of the Defense Science Board Task Force on Integrated Fire Support in the Battlespace*, 2.

stability operations simultaneously. The requirement to operate simultaneously will require the Field Artillery to improve systems and conduct some level of reorganization to improve the capability of tactical units conducting decentralized operations. The first supporting function of the Field Artillery is to coordinate and integrate joint fires. The second supporting function of the Field Artillery is to develop an inherent capability to conduct nonstandard missions similar to maneuver organization because the U.S. Army anticipate that the Field Artillery will perform nonstandard missions in the future.<sup>55</sup>

As warfare continues to evolve and become more complex, the Field Artillery will have to answer hard questions about organizational changes that are necessary to support the U.S. Army's future operating concept. Unified Land Operation doctrine resembles Active Defense, Air Land Battle, and Full Spectrum Operations in that the U.S. Army will institutionalize the concept during a period of budgetary constraints and mandatory reduction of overall force structure following years of war. Because of budget constraints and reduction in force strength, the Field Artillery must develop a plan that is flexible and adaptable to allow room for change.

#### Functional Concept for Fires and Field Artillery Doctrine

In 2011, TRADOC's published the Functional Concept for Fires to describe the future capabilities the U.S. Army require of the Field Artillery in 2016-2028. The Functional Concept for Fires (FCF) established the overarching fires solutions and required resources needed to enable the U.S. Army to overcome future enemies and succeed in a wide range of contingencies. The transition of TRADOC broad overarching concept for fires into an effective fighting force required an assessment of the current state of the Field Artillery and the development of a plan to minimize gaps in capabilities in order to meet future requirements. The Field Artillery must make

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<sup>55</sup>Department of the Army, TRADOC Pam 525-3-4 *Functional Concept for Fires 2016-2028*, 5.



structural and capability changes to the Field Artillery system in order to overcome shortfalls and challenges associated with the uncertainty of the future.

The TRADOC Pam 525-3-1 United States Army Operating Concept (AOC) and TRADOC Pam 525-3-4 Functional Concept for Fires 2016-2028 referred to future capabilities of the Field Artillery as *operational adaptive*. The AOC uses the term *operational adaptive* to describe the flexibility that is required of Field Artillery units in the future into three specific categories. The Field Artillery is operationally adaptive when it can decentralize capabilities at lower echelons to support operations, when Field Artillery units can task organize with non-fires capabilities to conduct nonstandard missions, and when the Field Artillery can operate as a mixed force performing both standard and nonstandard missions simultaneously.<sup>56</sup> ADRP 3-09 *Fires* defined future requirements for the Field Artillery as *scalable capabilities*, which is a range of lethal and nonlethal activities that are scalable, adaptable, versatile, and capable of achieving intended effects.<sup>57</sup>

### Reluctance to Change

The Field Artillery has decentralized capabilities to lower echelons to an extent but organizational culture historically associate longer-range systems with higher levels of command. Because of the nature of the environment in Iraq, Afghanistan, and anticipated for the future the logic of associating weapon systems range with level of headquarters is largely irrelevant and hinders maneuver brigades ability to have organic scalable fires.<sup>58</sup> The Field Artillery has not

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<sup>56</sup>Department of the Army, TRADOC Pam 525-3-1 *Army Operating Concept* (Ft Monroe VA: HQs U.S. Army Training and Doctrine Command, 2010), 53.

<sup>57</sup>U.S. Department of the Army Doctrine Publication (ADP) 3-09, *Fires*, 4.

<sup>58</sup>Jonathan Bailey, "Artillery in Decline? The Future of the Field Artillery" *RUSI Defense Systems*, (Autumn 2006): 3.

drastically changed the structure of organic fires assets available at the brigade level even though the Brigade Combat Team is the primary fighting force of the U.S. Army.<sup>59</sup> Field Artillery organizations should be proportionate to the supported maneuver forces in maneuverability, survivability, and operational reach.<sup>60</sup> Each brigade should be fielded the appropriate MLRS launcher or HIMARS system according to track or wheeled platform.

Maneuver brigades should be allocated standard rockets and Guided MLRS Unitary rockets to support brigade operations. The Guided MLRS Unitary rocket (GMLRS) can strike a target within two meters at a distance of seventy kilometers.<sup>61</sup> The MLRS rocket has the precision, range, and lethality to improve the capability of maneuver brigades to conduct offensive, defensive, and stability operations. Brigade Combat Teams operations in Iraq and Afghanistan have proven the need for extended range and precision capability to destroy, suppress, or neutralize targets across large areas of operations. During Operation Iraqi Freedom I, 3<sup>rd</sup> Infantry division artillery fired 794 rockets to support brigade combat teams during initial operations. LTC Ferrell a squadron commander in the 3<sup>rd</sup> Infantry division during initial operations in OIF I stated, “MLRS rockets was the only system capable of destroying attacking forces in adverse weather conditions.”<sup>62</sup> The Field Artillery should continue to manage ATACMS at division and corps level due to airspace coordination requirements, cost of munition, and limitation of munition availability.

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<sup>59</sup>Department of the Army Field Manual 3-90.6, *Brigade Combat Team* (Washington D.C.: Government printing Office [GPO], September 2010), 1-7.

<sup>60</sup>Bailey, “Artillery in Decline? The Future of the Field Artillery”, 4.

<sup>61</sup>Marine Corps University, *U.S. Field Artillery Relevance on the Modern Battlefield*, 3.

<sup>62</sup>Colonel Thomas G. Torrance and LTC Noel T. Nicolle U.S. Army, “Marne Thunder the 3<sup>rd</sup> Division Artillery in Operation Iraqi Freedom” *Army* (April 2004): 59-60.

The MLRS precision attack missile and ATACMS remain a relevant option for the Department of Defense for precision strike and shaping operations but recently have been amongst the lowest in priority for employment in recent operations. Historically the Field Artillery provide direct support to conventional forces but should consider establishing a formal relationship with SOF to support covert operations in the future. During Operation Iraqi Freedom, a HIMARS platoon successfully supported SOF operations firing forty ATACMS against operational and strategic targets.<sup>63</sup> The HIMARS provides long-range precision capability that is transportable by strategic airlift and operational within minutes of landing.<sup>64</sup> The HIMARS system meets the requirement of SOF forces as a fires asset to provide the deployment range, munition range, and accuracy with the precision of the guided missile or rocket.

The AOC clearly stated that the Field Artillery is operationally adaptive when Field Artillery units can task organize with non-fires capabilities to conduct nonstandard missions and when the Field Artillery can operate as a mixed force performing both standard and nonstandard missions simultaneously.<sup>65</sup> The Field Artillery units will more than likely continue to perform nonstandard missions to the benefit of the U.S. Army when maneuver operations require less fire support during counter-insurgency and stability operations.<sup>66</sup> FM 3-09 *Fires* does not address operational adaptive or nonstandard missions as a key principle for the Field Artillery. The reluctance to institutionalize nonstandard missions will degrade unit readiness, and marginalizes Field Artillery units in the future. In the past twelve years of war when the Field Artillery was not

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<sup>63</sup>Product Manager-High Mobility Artillery Rocket System (PM-HIMARS), *HIMARS: Operation Iraqi Freedom* (Redstone Arsenal, AL: PM-HIMARS, 2003), 6.

<sup>64</sup>Marine Corps University, *U.S. Field Artillery Relevance on the Modern Battlefield*, 36.

<sup>65</sup>Department of the Army, TRADOC Pam 525-3-1 *Army Operating Concept*, 55.

<sup>66</sup>Bailey, “Artillery in Decline? The Future of the Field Artillery”, 4.

performing traditional mission Fires brigades conducted nonstandard missions to support corps and theater operations like theater detention operations, FOB security, sustainment convoy escort, and security forces assistance. Field Artillery battalions aligned with maneuver brigades performed a wider range of missions but traditionally organized as a mixed force conducting both traditional field artillery missions and motorized infantry operation. The Field Artillery needs to define the mission essential task assigned to Field Artillery brigades and Field Artillery battalions that support brigade combat teams. Including nonstandard missions in doctrine and home station training will improve the versatility of Field Artillery units supporting operations in the future.

#### An Option for Scalable and Adaptive Fires

As the nature of warfare change and the U.S. Army increase responsibility of smaller units the Field Artillery must decentralize artillery units to align the right capabilities to support future operations, prepare Field Artillery units for nonstandard missions, and increase the role of the Field Artillery in operational and strategic level fires. The Field Artillery should expand the concept of scalable capabilities to include reducing the requirement for general support artillery by decentralizing artillery rocket systems in direct support brigade combat team. The Field Artillery can become operationally adaptive by preparing Field Artillery units to conduct specific nonstandard missions when required. Lastly, in order to reestablish the role of the Field Artillery as a relevant option for strategic and operational level fires a direct support relationship between the Field Artillery and SOF could increase the use of long-range artillery in support of future operations.

#### Improving Operational and Strategic Level Fires

The U.S. Army four active Corps headquarters should add one battalion of MLRS or HIMARS weapon systems to the Corp special troop brigade (STB). The MLRS or HIMARS battalion would provide the corps ATACMS and precision strike capability to complement joint

assets with shaping operations. Establishing a direct relationship with the corps headquarters benefits the MLRS battalion with focused predeployment training for both standard and nonstandard missions under the U.S. Army's global regional alignment concept. In potential environments that demand large amounts of surface-to-surface fires, the U.S. Army Reserve and National Guard Fires brigades could augment corps with required assets. Because corps formations are regionally aligned with geographic combatant headquarters Field Artillery deep strike battalions could establish direct support relationships with special operations forces aligned to the same region for future operations.

#### Scalable Fires across the Army

Even though the Field Artillery plans to create four additional Fires brigades by 2016 to align with division headquarters, an alternate plan may be required because the Department of Defense continue to decrease force structure in a budget-constrained environment. The Army should reevaluate the general support artillery structure in order to increase responsiveness of fires in the future by decentralizing capabilities to the lowest level. Restructuring MLRS and HIMARS units to have an organic direct support relationship to maneuver brigades would decrease the requirement for Fires Brigades to provide general support artillery. Each active division headquarters should have a Fires Brigade that consists of two battalions with a headquarters capable of adding additional battalions as mission dictates. Armored divisions should receive one battalion of M270A1 weapon systems and one composite battalion of eight HIMARS and eight Paladin weapon systems. Infantry divisions would receive one battalion of HIMARS weapon systems and one battalion of M777 howitzer weapon systems. Recommended structure provide the Fires brigade the capability to continue to support division operations primarily by influencing the division area of operations and providing counter fire against enemy artillery threats.

With the U.S. Army restructuring plan for BCTs an additional maneuver battalion will be added in the future, therefore the Fires battalion will have to increase force structure. A proposed structure of the Fires battalion within the brigade is debatable but an initial recommendation would be to add an additional battery of eight weapon systems. HIMARS and MLRS systems should be added to traditional weapon systems organic to maneuver brigades to increase the scalable capability of indirect fires at the brigade combat team level. The recommendation is that the additional battery is a composite battery with eight weapon systems. Composite Fires battalion will have increased range, accuracy, and lethality available to support brigade combat teams. The composite battery organic to Armored and Infantry brigades should consist of a platoon of four M777 howitzers and a platoon of four M270A1 launchers or HIMARS compatible weapon system. The Stryker brigade is unique that is already have a three battery six howitzer structure. Therefore, one HIMARS platoon should be assigned to Stryker brigades to increase the capability of the organic Fires battalion.

#### Standardized Nonstandard Missions

Current Field Artillery doctrine clearly defined the functions of the Field Artillery for shaping fires, counter fire, and close supporting fires, but doctrine does not provide a plan to prepare Field Artillery units to conduct nonstandard missions in the future. The Field Artillery needs to reevaluate lessons learned as early as the Vietnam War and U.S military conflicts since the 1990s to consider the proper organization of Field Artillery units to support a wide range of military operations in the future. Throughout the 1990s, the U.S. Army deployed Field Artillery units to conduct a mix of traditional and nonstandard missions in Somalia, Haiti, Bosnia, and Kosovo. In Iraq and Afghanistan, the Field Artillery performed a mixed of standard and nonstandard missions as well. During stability operations in Iraq and Afghanistan Field Artillery brigades provided a limited number of HIMARS platoons and target acquisition platoons to support force protection operation. The remaining of the Field Artillery brigade conducted

nonstandard missions like supporting theater detention operations, transportation of theater sustainment supplies, forward operating base security, and security force assistance. Most of the nonstandard missions conducted by the Field Artillery brigade in Iraq and Afghanistan were in support of corps or land component headquarters. In accordance with the proposed structure of aligning Field Artillery units with corps, division, and brigade combat teams, the Field Artillery could increase unit readiness to conduct nonstandard missions in future operations by adding task to Field Artillery mission essential task list.

## CONCLUSION AND RECOMMENDATIONS

The Field Artillery needs a plan for the future that continues to integrate technological advances to increase range, accuracy, and efficiency of the Field Artillery sensor to shooter system. Future innovation in technology needs to compliment Field Artillery support to offense, defense, and stability operations equally. The failure to field future systems that cannot provide universal fire support will degrade the effectiveness of the Field Artillery under ULO doctrine. The Field Artillery has proved throughout history that it can provide offensive and defensive fires but has not implemented significant changes to increase the utility of Field Artillery units in support of stability operations.

The Army Operating Concept and the Army Functional Concept for Fires (FCF) 2016-2028 provided overarching conceptual framework for fires in future operations. The Army's core competencies of combined arms maneuver and wide area security provide the means for balancing the application of combat power within tactical tasks associated with offensive, defensive and stability operations. Field Artillery lessons learned during Iraq and Afghanistan have demonstrated a need to develop a flexible force capable of massing fires and decentralizing capabilities in small elements to provide close supporting fires to maneuver forces. The U.S. Army guidance for future fires has broadened the role for the Field Artillery by defining

capabilities as operationally adaptive and scalable fires. Current Field Artillery doctrine has not institutionalized the operationally adaptive and scalable fires concepts to the extent outlined in the guidance for the future. The Field Artillery has been hesitant to change from the current concept of distributed fires to scalable fires. The current organizational structure that the Field Artillery has recommended to meet the needs of the future has not increased the capability of Field Artillery units to support decentralize operations.

Considering the U.S. Army has designated maneuver brigades as the main fighting force the Field Artillery needs to increase the capability of direct support fires assets supporting brigade combat teams by developing composite units that include organic rocket artillery support. The proposed composite battalion option will improve the versatility of organizations by balancing similar capabilities between heavy and light organizations. The precise composition comprises of a mix of cannons, rockets, and sensors to complement field artillery and combined arms maneuver formations. In the past, task organization of Field Artillery units was done primarily at the field artillery brigade-level or through assignment of field artillery tactical missions to brigades and battalions. The future will require indirect fires units to task organize at battalion and battery levels to create composite units with multiple capabilities. Mission command systems must enable decentralized control of composite units and widely dispersed firing elements.

The future operating environment requires the integration of Army offensive and defensive indirect fires (cannons and rockets) capabilities with the capabilities of other Army warfighting functions, special operations forces, joint services, interagency, and multinational partners. The U.S Army should expand the role of the Field Artillery to provide direct support fires to special operations forces and reorganize Field Artillery units with corps headquarters to establish a dedicated deep strike fires asset to support future operations under the regional alignment concept. The Field Artillery has not capitalized on the versatility that the HIMARS system provides with its C-130 rapid deployable capability and operational reach. A direct



relationship with SOF could increase the role of the Field Artillery in the future and reestablish the Field Artillery as a legitimate option for shaping operations.

The Field Artillery branch needs to accept the fact the U.S. Army is not trying to eliminate the Field Artillery branch but wants to expand the role of the Field Artillery beyond providing fires in support of conventional forces. The guidance for the Field Artillery in the Functional Concept for Fires 2016-2028 focused extensively on increasing the capability of fires in support of stability operations. The Field Artillery needs to prepare units to conduct alternative missions in support of operations because the U.S. Army anticipates the use of lethal fire will be limited in support of stability operations. The Field Artillery needs to accept that the future will require the Field Artillery to move away from the traditional concept of distributed fires to meet the requirements for decentralized operations. The Field Artillery will remain an essential asset to the U.S. Army in the future because of its contribution to offensive and defensive operations. However, if the Field Artillery wants to end the perception that the branch is on the demise, the Field Artillery will have to make major organizational changes in the near future to provide the U.S. Army a versatile fires capability to support ULO.

## BIBLIOGRAPHY

- Association of the United States Army. "Key Issues Relevant to U.S. Army Fires and the Warfighter." *Torchbear*, October, 2009.
- Bailey, Jonathan. *Field Artillery and Firepower*. Annapolis, MD: Naval Institute Press, 2004.
- Bailey, Jonathan. "Field Artillery: Enduring Importance and Future Challenges." *Military Technology*, September, 2005.
- Bailey, Jonathan. "Artillery in Decline? The Future of the Field Artillery." *RUSI Defense Systems*, Autumn, 2006.
- Barnes, Randall T., COL U.S. Army, *The New Army and Its Use of Joint Fires*. Carlisle, PA: U.S. Army War College, 2006.
- Bar-Yam, Yaneer. *Making Things Work: Solving Complex Problems in a Complex World*. Boston, MA: Knowledge Press, 2004.
- Brown, Kirby. "Field Artillery Capabilities Update." FCOE Capabilities Development and Integration Directorate, [http://www.dtic.mil/ndia/2008psa\\_peo/Brownday2.pdf](http://www.dtic.mil/ndia/2008psa_peo/Brownday2.pdf) (accessed on 12 January 2013).
- Dastrup, Boyd. *King of Battle: A Branch History of the U.S. Army's Field Artillery*. Fort Monroe, VA: HQs U.S. Army Training and Doctrine Command Office of the Historian, 1991.
- Dastrup, Boyd. *Modernizing the King of Battle 1973-1991*. Fort Sill, OK: Office of the Command Historian U.S. Army Field Artillery Center and School, 2003.
- Office of the Secretary of Defense. *Report of the DSB Task Force on Integrated Fire Support in the Battlespace*. Washington, D.C.: Defense Science Board (DSB), 2004.
- Fontenot, Gregory. *On Point: The United States Army in Operations Iraqi Freedom*. Ft Leavenworth, KS: Combat Studies Institute Press, 2004.
- Garcia, Manuel, MAJ U.S. Army. *The Pursuit of Precision in the Field Artillery*. Ft Leavenworth, KS: School of Advanced Military Studies, 2010.
- Gharajedaghi, Jamshid. *Systems Thinking: Managing Chaos and Complexity*. Oxford, UK: Elsevier, 2006.
- Halverson, Davis, Major General, and Colonel Steven L. Hite. "Adaptable Fires in Support of Full Spectrum Operations." *Army*, July, 2011.
- Hartig, Michael, J. COL U.S. Army. *The Future of the Field Artillery*. Carlisle, PA: U.S. Army War College, 2010.
- Huiss, Randy. *Proliferation of Precision Strike: Issues for Congress*. Washington, D.C.: Congressional Research Service, May 2012.

- Jacobs, Jody. *Enhancing Fires and Maneuver Capability Through Greater Air Ground Joint Interdependence*. Santa Monica, CA: RAND Corporation, 2009.
- Johnson, David E. *Learning Large Lessons: The Evolving Roles of Ground Power and Airpower in the Post-Cold War Era*. Santa Monica, CA: RAND Corporation, 2007.
- Junker, Kirk, J. MAJ U.S. Army. *The Field Artillery in Combined Arms Maneuver and Wide Area Security Operations*. Fort Leavenworth, KS: U.S. Command and General Staff College, 2011.
- Kolessar, John M. MAJ U.S. Army. *What's the 411 for the U.S. Army Operational Level Fires*. Fort Leavenworth, KS: School of Advanced Military Studies, 2000.
- Lawson, Bryan. *How Designers Think*. Burlington, MA: Architectural Press, 2006.
- Marine Corps University. *U.S. Field Artillery Relevance on the Modern Battlefield*. Quantico, VA: Marine Air Ground Training and Education, Combat Development Command, 2004.
- McGrath, John J. *Fire for Effect: Field Artillery and Close Air Support in the US Army*. Ft Leavenworth, KS: Combat Studies Institute Press, 2008.
- McKenney, Janice E. *The Organizational History of the Field Artillery 1775-2003*. Washington, D.C.: Center Of Military History, 2007.
- McKiernan, Brian, Brigadier General U.S. Army. "Shaping the Future: In an Uncertain Environment." FCOE, <https://www.us.army.mil/suite/2012fieldartillerybriefs> (accessed on 10 January 2013).
- Mets, David and Harold R. Winton. *The Challenge of Change*. Lincoln, Nebraska: University of Nebraska Press, 2000.
- Mintzberg, Henry. *The Rise and Fall of Strategic Thinking*. New York, New York: The Free Press, 1994.
- Nicolle, Noel, COL U.S. Army. *Effects of Modularity on the Field Artillery Branch*. Carlisle, PA: U.S. Army War College, 2009.
- Product Manager-High Mobility Artillery Rocket System (PM-HIMARS). *HIMARS: Operation Iraqi Freedom*. Redstone Arsenal, AL: PM-HIMARS, 2003.
- Ralston, David, Major General U.S. Army. "Field Artillery Azimuth 2005-2015." *Field Artillery Magazine*, November-December, 2005.
- Richardson, Richard, MAJ U.S. Army. *Army After Next: End of the Line for the Field Artillery Standard Tactical Mission*. Fort Leavenworth, KS: School of Advanced Military Studies, 1999.

- Romjue, John L. *From Active Defense to Air Land Battle: The Development of the Army Doctrine, 1973-1982*. FT Monroe, VA: HQ US Army TRADOC Office of the Command Historian, 1984.
- Tracy, Tommy, LTC U.S. Army. "Field Artillery at the Crossroads of Transformation." *Military Review* (January-February 2004): 32-44.
- Torrance, Thomas G. COL U.S. Army and Noel T. Nicolle LTC U.S. Army. "Marne Thunder the 3<sup>rd</sup> Division Artillery In Operation Iraqi Freedom." *Army* (April 2004):59-60.
- Shalikashvili, John. "Joint Vision 2010: America's Military Preparing for Tomorrow", *Joint Force Quarterly* (Summer 1996).
- Stricklin, Toney, Major General U.S. Army. "The Field Artillery in Transformation." *Field Artillery Magazine*, September-October, 2000.
- U.S. Department of the Army Doctrine Publication 3-0. *Unified Land Operations*. Washington, DC: Government Printing Office [GPO], August 2011.
- U.S. Department of the Army Doctrine Publication 3-09. *Fires*. Washington, DC: Government Printing Office [GPO], August 2012.
- U.S. Department of the Army Doctrine Reference Publication 3-0. *Unified Land Operations*. Washington, DC: Government Printing Office [GPO], May 2012.
- U.S. Department of the Army Doctrine Reference Publication 3-09. *Fires*. Washington, DC: Government Printing Office [GPO], August 2012.
- U.S. Department of the Army, Field Manual (FM) 3-0. *Operations*. Washington, DC: U.S. Department of the Army, 14 June 1993.
- U.S. Department of the Army Field Manual (FM) 100-5. *Operations*. Washington D.C: Department of the Army, July 1976.
- U.S. Department of Defense Office of the Secretary of Defense. *The Implementation of Network Centric Warfare*. Washington, DC: Director of Force Transformation, 2005.
- U.S. Department of the Army TRADOC Pamphlet 525-3-1. *The U.S. Army Operating Concept*. Washington, DC: Training and Doctrine Command, 2010.
- U.S. Department of the Army TRADOC Pamphlet 525-3-4. *The U.S. Army Functional Concept for Fires 2016-2028*. Washington, DC: Training and Doctrine Command, 2010.
- U.S. Joint Publication 3-0. *Joint Operation*. Suffolk, VA: Joint Doctrine Support Division, August 2011.
- U.S. Army Field Artillery School. *Right of the Line: A History of the American Field Artillery*. Ft Sill, OK: Field Artillery School, 1984.

Waters, Mark, COL U.S. Army. *Precision and the Blue Collar Artillery*. Carlisle, PA: U.S. Army War College, 2006.

White, Samuel, COL U.S. Army. *Transformation of the Artillery Branch*. Carlisle PA: U.S. Army War College, 2007.